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In re Application of:	Group Art Unit: 3683
Jack Cheng et al.	Examiner: Nguyen, Xuan Lan T
Serial No.: 09/723,615	**RESPONSE TO ADVISORY ACTION DATED May 6, 2003**
Filed: November 27, 2000	
For: **SMART SONIC BEARINGS AND METHOD FOR FRICTIONAL FORCE REDUCTION AND SWITCHING**	162 North Wolfe Road Sunnyvale, CA 94086 (408) 530-9700 Customer Number 28960

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Sir:

REMARKS

This response accompanies a request for continued examination (RCE) of U.S. Patent Application Serial No. 09/723,615 filed on November 27, 2000. The Applicant respectfully requests further examination and reconsideration in view of the references cited in the accompanying Information Disclosure Statement and arguments set forth below. Currently, Claims 1, 2, 3, 4, 16, 17, and 143, 145-148 are now pending.

It is stated within the Advisory Action that Claims 145-148 and Claim 143 are directed to a non-elected species. The Applicants respectfully disagree. In the Response dated April 5, 2002, the Applicants elected Sub-species II(A-J)2 which includes Figures 7A, 7B, 8A-8F, 9A, 9B, 10 and 15A-15C. The Applicants respectfully submit that Claims 143, 145-148 are directed to the elected species in Sub-species II(A-J)2.

The present invention alters the effective coefficient of friction by inducing a repetitive motion in a first element against a second element, whereby the motion of the first element at the anti-nodal regions against the surface of the second element changes the effective coefficient of friction in between the two surfaces. The first element horizontally expands and contracts while it is energized while it undergoes the repetitive motion. During expansion, the ends of the first element move away from the center, whereby the change in length causes the thickness of the

nodal region of the first element to decrease in size. In contrast, during contraction, the ends move toward the center of the element, whereby the change in length causes the thickness of the nodal region of the first element to increase in size or "bulge". In other words, the change in horizontal length in the first element while energized causes the center of the first element to undergo a vertical dimension change. The center of the first element is defined in the present specification as the nodal region. The anti-nodal region of the first element as defined in the present specification is where there is minimal vertical change. As shown in Figures 8A-8C, the bearing element 100 includes the anti-nodal regions, designated as having thickness Z_0, which is where the vertical distance of the bearing element does not change. In addition, Figure 10 illustrates the bearing element 100 and the load member in contact with the contact pads, whereby the contact pads are placed at the anti-nodal regions in accordance with the present invention. Furthermore, Figures 15A-15C illustrate different embodiments of the bearing element having contact pads configured thereon, whereby the load member is shown being placed in contact with the contact pads.

Claim 143 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of: configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface, the first element having a nodal region and at least one anti-nodal region, wherein the interface is located only along the anti-nodal region of the first element, the first and second surfaces under a force sufficient to maintain contact at the interface and having a static friction therebetween; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction. As stated above, Figure 8A-8C illustrate the anti-nodal regions in the bearing maintaining the thickness designated Z_0, whereby the anti-nodal regions do not experience vertical displacement. Figures 10 and 15A-15C as well as the accompanying description describe the first element in contact with the second element only at the anti-nodal regions. For at least these reasons, the subject matter in Claim 143 is disclosed in the elected figures and accompanying description and is directed to the elected species. Therefore, Claim 143 is subject to examination.

Claim 145 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of: configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface and under a force

sufficient to maintain contact and having a static friction therebetween; configuring a set of contact pads on the first element, the second surface in contact with the contact pads at the interface; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction, wherein the first surface remains in contact with the contact pads in the set at the interface. As stated above, Figures 8A-8C illustrate contact pads configured on the bearing element. In addition, Figure 10 illustrates the second surface in slidable contact with the contact pads at the interface on the first surface. Figures 15A-15C illustrate exploded views of different embodiments having the second surface is contact with the contact pads of the interface on the first surface. For at least these reasons, the subject matter in Claim 145 is disclosed in the elected figures and accompanying description and is directed to the elected species. Therefore, Claim 145 is subject to examination.

Claim 146 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of: configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface at a plane and under a force sufficient to maintain contact and having a static friction therebetween; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction between the first and second surfaces, wherein the interface remains substantially at the plane unaltered by the repetitive motion. As stated above, Figures 8A-8C illustrate the anti-nodal regions in the bearing maintaining the thickness designated Z_0, whereby the anti-nodal regions do not experience vertical displacement. In other words, the anti-nodal regions remain along a plane and preferably do not move out of the plane when the bearing element is in motion. Figure 10 illustrates the load member in contact with the bearing element at the interface which is preferably the contact pads. Thus, Claim 146 is illustrated in the elected figures and accompanying description and is therefore subject to examination.

Claim 147 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of: configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface at a plane, wherein the interface is located along an anti-nodal region of the first element, the first and second surfaces under a force sufficient to maintain contact at the interface and having a static friction therebetween; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction, wherein the interface between the first and

second surface remains substantially at the plane unaltered by the repetitive motion. As stated above, Figures 8A-8C illustrate the anti-nodal regions in the bearing maintaining the thickness designated Z_0, whereby the anti-nodal regions do not experience vertical displacement. In other words, the anti-nodal regions remain along a plane and preferably do not move out of the plane when the bearing element is in motion. Figure 10 illustrates the load member in contact with the bearing element at the interface, preferably at the contact pads, which is in the plane. Thus, Claim 147 is illustrated in the elected figures and accompanying description and is therefore subject to examination.

Claim 148 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of: configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface, wherein the interface is located along an anti-nodal region of the first element, the first and second surfaces under a force sufficient to maintain contact at the interface and having a static friction therebetween; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction, wherein the force is substantially unaltered by the repetitive motion. As stated above, Figures 8A-8C illustrate the anti-nodal regions in the bearing maintaining the thickness designated Z_0, whereby the anti-nodal regions do not experience vertical displacement. In other words, the anti-nodal regions remain along a plane and preferably do not move out of the plane when the bearing element is in motion. Figure 10 illustrates the load member in contact with the bearing element at the interface. In addition, Figure 10 illustrates the forces applied to the load member. Therefore, Claim 148 is illustrated in the elected figures and accompanying description and is therefore subject to examination.

Rejections in View of Massa

Within the Advisory Action, Claims 1-4, 16, 17 and 143 were rejected as anticipated by Massa. Specifically, it is stated within the Advisory Action that there is no disclosure of a vertical displacement of element 2 nor an air cushion between elements 2 and 1. The Applicants respectfully disagree.

The Applicants have submitted two cited references in the accompanying Information Disclosure Statement, particularly, "Development of Friction Controller" by Kutomi et al. (hereinafter Kutomi) and "Control of Friction Coefficient Between Metal Surfaces" by Sase et al. (hereinafter Sase). The Applicants specifically refer to Kutomi and Sase in the arguments below

to show that the body 2 in Massa does experience vertical displacement from the bearing 1 which thereby changes the actual, instead of the effective coefficient of friction between the body 2 and bearing 1.

Kutomi and Sase are related to one another and both disclose a device which changes the actual coefficient of friction between two mated slidable bodies by introducing a stress wave into one of the two bodies. Sase explains that the coefficient of friction can be decreased by inducing stress waves through slight impacts into the guideway member (Figure 1 of Sase). However, Sase identifies that the problem with inducing stress waves into the guideway member is that the sliding member will undergo larger oscillations as a result of a higher frequency of impacts into the guideway member. Therefore, Sase admits that the sliding member experiences vertical displacement from the vibrating guideway member, and that the sliding member will levitate off of the vibrating guideway member when the vibrating frequency of the guideway member is too high.

Sase seeks to measure the amount of vertical displacement in the guideway member caused by the high frequency vibrations transmitted by the impactor. Figure 1 in Sase illustrates a piezo-electric impactor mounted to the end of the guideway member, whereby the impactor applies a vibration in the frequency of 20 kHz into the guideway member. In addition, a slider having a sliding plate and a dynamometer is placed on top of the guideway member. Sase discloses that it was found that the surface of the **guideway member moved in the vertical z-direction** when it vibrated in response to the vibrations from the impactor. In other words, the guideway member experienced vertical displacement as a result of the impactor transmitting acoustic waves into the guideway member through the end of the guideway member, as in Massa.

Kutomi further explains the findings in the Sase reference, whereby the purpose in Kutomi was to develop a method to control the friction coefficient between the guideway member and the sliding member. Kutomi confirms Sase's contention that the actual coefficient of friction is decreased when a stress wave is induced in the guideway member. Kutomi disagrees with the same position taken in the Advisory Action in that the body attached to the oscillating member only experiences horizontal displacement. Kutomi addresses that it was assumed in a prior paper that the contact areas were distributed evenly between the slider and the guideway member. Kutomi expressly admits that the prior assumption was improper, because an impactor which provides vibrations in the horizontal direction into a body will also transmit vertical vibrations into the body through the law of Poisson's ratio. Kutomi finds that the friction

coefficient is high at the node of resonance of the stress wave, and the friction coefficient is low where the amplitude of vertical vibration is large. In other words, Kutomi admits that the vertical displacement in the bearing plays a significant role in decreasing the actual coefficient of friction, because the actual coefficient of friction is low where the vertical displacement is large.

In comparison to Sase and Kutomi, Massa teaches an oscillator which supplies acoustic waves into the body 1, whereby the vibrations in the body 1 decrease the actual coefficient of friction between the body 1 and the sliding body 2. It is the position in the Advisory Action that there is no disclosure of vertical displacement in the body 1. This position is mistaken. The structure and operation of the device in Sase is the same as in Massa. Massa has the oscillator attached to the end of the body 1, whereby the impactor in Sase is attached to the end of the guideway member. The oscillator in Massa transmits vibrations into the body 1, whereby the impactor in Sase transmits the vibrations into the guideway member. There is no hint, teaching or suggestion in Massa that the bearing undergoes only horizontal motion. In fact, Massa teaches away from the bearing 1 moving only in the horizontal direction, because Sase, having the same structure and operation as Massa, teaches that the body undergoes vertical displacement. In addition, there is no hint, teaching or suggestion in Massa, Sase or Kutomi that any device or method is used to remove the interactions of the vertical movement between the sliding member and the vibrating bearing. Therefore, Sase and Kutomi confirm the Applicants' prior assertions and arguments that the bearing 1 in Massa undergoes vertical as well as horizontal displacements, wherein the sliding body 2 experiences these vertical displacements.

Furthermore, the reduction in the coefficient of friction provided in Sase and Kutomi are similar to that described in Massa confirm that Massa is different than the present invention. As stated above, the sliding body in Massa, Sase and Kutomi experiences vertical displacements of the bearing which directly causes the actual coefficient of friction to be reduced. Massa teaches a reduction in the actual coefficient of friction by a factor of 10, whereas Sase teaches a reduction by a factor of 2 and Kutomi teaches a reduction by a factor of 6. In contrast, the present invention shows a reduction of the **effective** coefficient of friction by a factor of over 130, as shown in Figure 11A. Comparing these results for the reduction friction factor clearly shows that the present invention does not employ the same phenomena as in Massa, Sase and Kutomi. Again, these results confirm that the present invention does not reduce the actual coefficient of friction, but instead reduce the effective coefficient of friction between the bodies.

The Applicants again contend that the present invention is distinguishable from Massa, because the sliding member in the present invention is only in contact with the anti-nodal regions of the bearing element. Thus, the sliding member does not substantially experience any vertical motion, but substantially experiences only horizontal motion, from the repetitive motion of the bearing. In contrast, as confirmed by Sase and Kutomi, the sliding body 2 in Massa experiences displacement of the bearing 1 in the vertical direction as well as the horizontal direction due to expansion and contraction of the bearing 1. This vertical displacement in the bearing 1 thus creates a change in the force holding the body 2 to the bearing 1 and, in some cases, creates an air cushion, because the vertical displacements attempt to push or "bump" the bottom surface of the sliding body 2 off the top surface of the bearing 1. Since an air cushion or at least a change in force holding the body 2 to the bearing 1 can be created due to the high frequency of "bumps," the actual static friction between the two objects decreases, which is quite different from the present invention.

Claim 1 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of: configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface and under a force sufficient to maintain contact and having a static friction therebetween; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction between the first and second surfaces, wherein the force is substantially unaltered by the repetitive motion. As stated above and confirmed in Sase and Kutomi, the bearing in Massa undergoes vertical and horizontal displacements along the interface between the bearing 1 and the sliding body 2. Thus, the sliding body 2 in Massa experiences the vertical displacements from the bearing's 1 vibrations, wherein the vertical displacements creates a change in the force holding the body 2 to the bearing 1. In some cases, the vertical displacements create an air cushion, because the vertical displacements attempt to push or "bump" the bottom surface of the sliding body 2 off the top surface of the bearing 1. Since an air cushion or at least a change in force holding the body 2 to the bearing 1 can be created due to the high frequency of "bumps," the actual static friction between the two objects decreases as confirmed in Sase and Kutomi. Claim 1 expressly states that the force holding the first element and the second element in contact with one another is substantially unaltered by the repetitive motion. For at lease these reasons, Massa does not read upon Claim 1 and is distinguishable from Claim 1. Accordingly, Claim 1 is allowable over the teachings of Massa.

Claims 2, 3, 4, 16 and 17 are dependent on the independent Claim 1. As stated above, Claim 1 is allowable over the teachings of Massa. Accordingly, Claims 2, 3, 4, 16 and 17 are also allowable as being dependent upon an allowable base claim.

Claim 143 is directed to a method of controlling an effective coefficient of friction between a first surface of a first element and a second surface of a second element, the method comprising the steps of: configuring the first and second surfaces to be in slidable contact with one another along an interface between the first surface and the second surface, wherein the interface is located only along an anti-nodal region of the first element, the first and second surfaces under a force sufficient to maintain contact at the interface and having a static friction therebetween; and inducing a repetitive motion in the first surface parallel to the interface thereby altering the effective coefficient of friction. As stated above, the anti-nodal regions in the bearing of the present invention are the regions which do not undergo any vertical displacement during expansion and contraction of the bearing. Since the sliding body 2 in Massa experiences vertical as well as horizontal displacement along the area of contact with the bearing, the sliding body 2 is necessarily in contact with the anti-nodal **and the nodal** regions of the bearing 1. In contrast to Massa, Claim 143 expressly recites that the first surface is in contact with the second surface along the interface, wherein the interface is **only** at the anti-nodal regions. For at least these reasons, Claim 143 is allowable over Massa. Therefore, Claim 143 is in a condition for allowance.

Applicant respectfully submits that the claims are now in a condition for allowance in light of the above arguments, and allowance at an early date would be appreciated. Should the Examiner have any questions or comments, they are encouraged to call the undersigned at (408) 530-9700 to discuss the same so that any outstanding issues can be expeditiously resolved.

Respectfully submitted,
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Dated: June 30, 2003

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